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PROXIMATE AND MINERAL COMPOSITION OF AMLA-PAPAYA JAM INCORPORATED WITH HONEY

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ABSTRACT

The aim of present study is to investigate the amla-papaya jam incorporated with honey by developing three jam formulations, designated as control, sample-A and sample-B and to analyse the proximate composition, physico-chemical properties, mineral composition, sensory attributes and microbial count. The study revealed that, the control was found to be high in the values of pH (3.26) and moisture content (34.02%) than the experimental samples. The sample-B was found to be high in total soluble solids (69.02%), carbohydrate content (61.31%), ash content (3.06%), calcium content (40.34 mg/100g) and ascorbic acid content (88.38 mg/100g) than the control and sample-A. The mean scores for sensory evaluation revealed that the sample-B was superior in all sensory attributes and the microbial count was also found to be low compared to both the control and sample-A. Hence it can be concluded that, the sample-B is more nutritious and highly acceptable in terms of sensory attributes and microbial quality.

KEYWORDS: Physico-Chemical Parameters, Sensory Evaluation, Microbial Analysis, Ascorbic Acid

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Original Article

INTRODUCTION

Fruits are considered as rich source of micronutrients, dietary fibre, phytochemicals and natural antioxidants that may benefit human health (Yahia, 2010; Shui and Leong, 2006). Fruits are known as protective foods and their consumption has been associated with a lowered incidence of diseases. However, the health promoting capacity of fruits depends on their processing. Processing affects the content, activity, bioavailability of nutrients and bioactive compounds. Only a small amount of fruits are consumed in their raw state, while most of them are processed for safety, quality and economic reasons (Nicoli et al., 1999). Many fruits are seasonal and perishable, their nutritional value and taste are decreasing as they spoil (Osvald and Stirn, 2008). The seasonality and perishability of fruits explain the need to apply preservation technologies (Giannakourou and Taoukis, 2003), including jam making.

Amla is potentially a good source of vitamin-C. It has medicinal properties and scope for processing into various juice beverages and jam (Singh and Kumar, 2000). According to Pathak et al., (2003) amla juice is rich in antioxidants, had showed cardio-protective effect. It offers a great potential for the development of many products owing to its excellent nutritive and therapeutic values (Deka et al., 2001). It is widely used in the pharmaceutical and food processing industries due to the presence of nutraceutical compounds (Jain and Khurdiya, 2002).

Papaya is an important fruit of India which is a rich source of papain and pectin. The edible portion of fruit consists primarily of water, carbohydrates, minerals and vitamins. According to the research conducted at

NIN, papaya is fairly a good source of vitamin-A, vitamin-C and β-carotene. It is an important source of carotenes, vitamin-C and Mg (Wall, 2006; Chandrika, 2003). Different mixed fruit jams were evaluated by Singh et al., (2009) and found a greater acceptance for papaya with pineapple, indicating the potential of the tropical fruits in the preparation of processed products.

Honey is a natural sweetener and has antimicrobial and antifungal properties (Molan, 1992). It is also used as a natural preservative and has good antioxidant properties and helps to improve the quality of food products (Shamala and Jyothi, 1999).

Jam is prepared from fruit pulp by boiling with sufficient quantity of sugar to a moderately thick consistency (Ranganna, 1977).There are different types of jams available in the market like strawberry jam, mango jam, pineapple jam, apple jam and mixed fruit jam etc.

Therefore, the present study was aimed to develop amla-papaya jam incorporated with honey and to evaluate the physico-chemical parameters, proximate, mineral composition, sensory and microbial analysis.

MATERIALS AND METHODS

Materials

The raw materials such as amla, papaya, honey and sugar were procured from the local market situated in Bapatla of Guntur district, Andhra Pradesh were used for the preparation of amla-papaya jam incorporated with honey.

Preparation of Amla-Papaya Jam incorporated with Honey

The standardization of amla-papaya jam incorporated with honey was carried out in the Department of Food Technology, College of Food Science and Technology, Acharya N. G. Ranga Agricultural University, Bapatla- 522 101, Guntur district of Andhra Pradesh during the year 2010-11 as shown in the "Table 1". A number of unit operations were carried out in the preparation of amla-papaya jam incorporated with honey as shown in the "Figure 1". Fruits of uniform colour, size and shape and firm ripe were selected and subjected for cleaning. After cleaning the amla and papaya fruits are washed separately in excess of potable water so as to remove the impurities. The fruits were blanched in hot water at a temperature of 60-70˚C for 5 minutes to stabilize the colour, to deactivate the enzymes and to soften the fruit pieces. After blanching the fruits were pulped by removing seeds and core and then sugar is added to them and then the whole mixture is subjected to boiling with continuous stirring. The judging point of jam was done when the sheets are formed or a TSS of about 68% is achieved. Then the jam is cooled and bottled in hot sterile glass bottles and stored at room temperature.

Table 1: Standardization of Amla-Papaya Jam incorporated with Honey

Ingredients	Control	Sample-A	Sample-B
Amla (g)	200	250	300
Papaya (g)	500	500	500
Sugar (g)	450	450	450
Honey (g)	0	20	40
Citric acid (%)	0.3	0.3	0.3

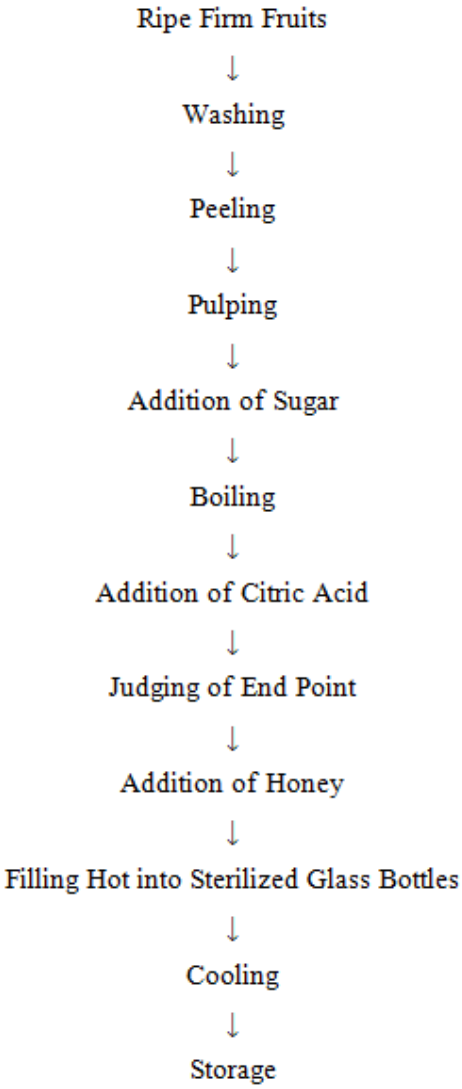

Figure 1: Process Flowchart for Preparation of Amla-Papaya Jam Incorporated with Honey

Evaluation of Amla-Papaya Jam incorporated with Honey

Samples of different formulations of amla-papaya jam incorporated with honey were evaluated for the following parameters such as proximate composition, physico-chemical parameters, mineral composition, sensory evaluation and microbial analysis.

Analysis of Proximate Composition

Determination of Moisture

Moisture content of samples were determined according to AOAC (2000) method by accurately weighing 5 g of the samples and drying in an hot air oven at 105° C for 2-3 hrs to a constant weight. The per cent moisture content was calculated as:

$$\% \text{ Moisture content, M} = \frac{W2-W3}{W2-W1} \times 100$$

Where,

M = Moisture content

W1 = Weight of empty crucible

W2 = Weight of crucible and sample before drying

W3= Weight of the crucible and sample after drying

Determination of Protein

The micro-kjeldahl method was used for the determination of protein content in samples by using the factor 6.25 for converting nitrogen content into crude protein (AOAC, 2000).The sample (1 g) was digested with concentrated sulphuric acid (20 ml) and digestion mixture (10 g) in Kjeldahl digestion flask. The digested sample was allowed to cool and then distilled into 2% boric acid solution containing methyl orange indicator, after being appropriately diluted with water and the introduction of 40% sodium hydroxide solution. The distillate was titrated with 0.1 N sulphuric acid. A blank sample was also run along with the samples. The per cent protein content was calculated as:

$$\% \text{ Nitrogen content} = \frac{(S-B)\times 0.1N \times 14.01}{\text{Weight of sample}} \times 100$$

$$\% \text{ Protein content} = \% \text{ N} \times 6.25$$

Where,

S= Sample titre value

B= Blank titre value

Determination of Fat

Fat content was determined using the soxhlet method (AOAC, 1995). The sample (2 g) was taken into the extraction thimble and the thimble was blocked with cotton wool. It was then placed in the soxhlet apparatus fitted with a weighed flat bottom flask, which was filled to about three quarter of its volume with petroleum ether with boiling point of 40-60°C. The extraction was carried out for a period of 4-8 hrs. Petroleum ether was removed by evaporation on water bath and the remaining portion in the flask was removed along with water during drying in an hot air oven at 80°C for 30 min. Defatted sample was then cooled in a desiccator and weighed. The per cent fat content was calculated as:

$$\% \text{ Fat content} = \frac{W2-W1}{W} \times 100$$

Where,

W = Weight of the sample

W1 = Weight of the empty beaker

W2 = Weight of the empty beaker + ether extract

Determination of Ash

The ash content of the samples was determined by the method described in AOAC (2000). The weight of the empty crucible was determined. The sample (5 g) was accurately weighed into a clean, dry, silica crucible and weighed

(W1). The crucible along with sample was placed in the muffle furnace at a temperature of 500-550° C for overnight until the sample completely turned into ash. Then, the crucible was removed and kept for cooling in a desiccator and weighed until a constant weight (W2). The per cent ash content was calculated as:

$$\% \text{ Ash content} = \frac{W2-W1}{W} \times 100$$

Where,

W = Weight of sample

W1 = Weight of sample + crucible before ashing

W2 = Weight of sample + crucible after ashing

Determination of Crude Fibre

The crude fibre content was determined as described in AOAC (1995). The sample (2 g) was weighed into a round bottom flask and 200 ml of 1.25% H_2SO_4 was added. The flask was placed on digestion apparatus with readjustable hot plate and boiled for 30 min., filter the contents through a filter paper. Wash the residue free of acid using hot distilled water and then transfer into the beaker to which add 200 ml of 1.25% sodium hydroxide. Digest the contents for half an hour, filter and wash free of alkali using hot distilled water. The residue was transferred to crucibles, weighed and dried in a hot air oven overnight at 105° C, and then placed in the muffle furnace at 550-600° C for 3 hrs. The loss in weight after ignition represents the crude fibre in the sample. The per cent crude fibre content was calculated as:

$$\% \text{ Crude fibre content} = \frac{\text{loss in weight}}{\text{weight of sample}} \times 100$$

Determination of Carbohydrates

The carbohydrate content in the samples was determined by using the Anthrone method as given in AOAC (1990). The per cent carbohydrate content was calculated as:

$$\% \text{ Carbohydrate content} = \frac{\text{mg of glucose}}{\text{weight of sample}} \times 100$$

Analysis of Physico-Chemical Properties

Determination of pH

The pH value of the samples was measured with a digital glass electrode pH meter at room temperature, which was calibrated prior to sample pH measurement using buffer solutions of pH value 4.0 and 7.0 (Ranganna, 1986).

Determination of Titrable Acidity

The titrable acidity of samples was measured according to the method given in AOAC (2000). The sample (1 g) was taken, diluted to 20ml with distilled water and titrated with 0.1 N NaOH using phenolphthalein as indicator. The end point is appearance of pink colour, which persists for few seconds. The titrable acidity can be calculated as:

$$\% \text{ Titrable acidity} = \frac{B \times 0.1 \times 0.064}{W} \times 100$$

Where,

B = Burette reading

W = Weight of sample

Determination of Total Soluble Solids (TSS)

The total soluble solids of the samples were measured by using the method described by Ranganna (1986). The sample (5 g) was weighed into a beaker and added 100-150 ml of distilled water. The contents were heated for 2-3 minutes, stirring with a glass rod, cooled and mixed thoroughly. After 20 minutes weigh the sample (0.01g), then filter through a filter paper. The filtrate was used for the determination of the total soluble solids of the samples using a hand refractometer (0 to 80 °Brix).

Analysis of Mineral Composition

Preparation of Samples for Mineral Content Analysis

The sample (5g) was weighed and taken in a crucible and subjected for ashing in a muffle furnace at a temperature of 550-600º C. The ash was taken in a digestion flask and digested with a mixture of concentrated nitric acid, sulphuric acid and per chloric acid. Then it was cooled to room temperature. The digested material made up to 100ml with distilled water.

Determination of Calcium

The calcium content present in the samples was determined by the method described by Raghuramulu et al., (1983). The titrimetric estimation of calcium was performed by precipitating it as calcium oxalate. The precipitate was dissolved in the sulphuric acid and the amount of calcium dissolved in the acid was determined by titrating against a standard potassium permanganate solution. The end point was determined by appearance of pink colour and persists for few minutes. The calcium content was expressed as mg of calcium per 100 g of sample. The calcium content was calculated using the formula as:

$$\% \text{ Calcium content} = (x - b) \times \frac{100}{2}$$

Where

x = ml of 0.01 N $KMNO_4$ required to titrate the sample

b = ml of 0.01 N $KMNO_4$ required to titrate 1N H_2SO_4

Determination of Phosphorus

The phosphorus content present in the samples was determined by the method described by Raghuramulu et al., (1983). The samples (2g) were subjected for ashing in muffle furnace at a temperature of 550-600° C for 2-3 hrs. The ash collected was dissolved in 5ml 5M H_2SO_4. Then, the sample ash was reacted with ammonium molybdate and aminonaphthol sulphonic acid, which was measured in a spectrophotometer at 650nm. A standard curve was prepared using potassium dihydrogen phosphate. The phosphorus content was expressed as mg of phosphorus per 100 g of sample. The phosphorus content was calculated by using the formula as:

$$\% \text{ Phosphorus content} = \frac{\text{O D of sample}}{\text{O D of standard}} \times 100$$

Determination of Iron

The iron content present in the samples was determined by the method described by Raghuramulu et al., (1983). The samples (2 g) were subjected for ashing in a muffle furnace at a temperature of 550-600° C for 2-3hrs. Then, the ash sample was digested using an acid mixture and reacted with potassium persulphate and potassium thiocyanate solutions. Red colour proportional to the iron content of the sample was developed in the solution. The O.D was measured using a spectrophotometer at 440nm. A standard curve was prepared using ferrous ammonium sulphate as standard. The iron content was expressed as mg of iron per 100 g of sample. The iron content was calculated by using the formula as:

$$\% \text{ Iron content} = \frac{\text{O D of sample}}{\text{O D of standard}} \times 100$$

Determination of Ascorbic Acid (Vitamin-C)

The ascorbic acid content of samples was measured by titration method as given by Ranganna, (1986), using 2, 6- dichlorophenol indophenol dye solution. The method of estimation involves the reduction of 2, 6- dichlorophenol indophenol dye to a colourless form by ascorbic acid in an alkaline solution. In the procedure followed, the dye solution was first standardized against standard ascorbic acid in order to determine the dye factor. The sample was diluted with 3% metaphosphoric acid and then the phosphoric acid extract of the sample was titrated against the dye solution until a pink colour was obtained which persists for few seconds. Ascorbic acid content was expressed as mg of ascorbic acid per ml, and was calculated by using the formula as:

$$\% \text{ Ascorbic acid content } = \frac{\text{titre volume} \times \text{dye factor} \times \text{volume made up}}{\text{aliquot of sample taken} \times \text{volume of sample}} \times 100$$

$$\text{Dye factor} = \frac{0.5}{\text{titre volume}}$$

Sensory Evaluation

The amla-papaya jam incorporated with honey was developed and subjected for hedonic scale to compare the mean scores of control and the formulated samples. Sensory analysis was carried out in the sensory evaluation laboratory, Department of Food Technology, College of Food Science and Technology, Bapatla. The panellists were selected solely on the basis of interest, time available and lack of allergies to food ingredients used in the study. On every occasion, the panellists were provided with the coded disposable paper cups containing different samples under investigation were carried out in isolated booths under fluorescent lighting and ambient conditions for sensory analysis. Samples were tested for different parameters like colour, taste, appearance, consistency and overall acceptability. All these tests, including the testing for consumer acceptance was done by sensory panellist according to 9 point hedonic scale for sensory evaluation as described by Girardot et al., (1952).

Determination of Microbial Load

Microbial limit test was done according to the method described by Speck (1992) to analyse the samples for microbial quality. Transfer 1 ml of diluted neutral sample into the sterile petri plates. Transfer 15-20 ml of sterilized media into the petri plates and allow it to solidify. Close the lids after the medium solidifies. Incubate the solidified plates in an inverted position in an incubator for 48 hrs at 37°C. After 48 hrs count the number of colonies and record the result for bacterial count, and for fungal count incubate the solidified plates in an upright position in an incubator for up to 5 days at 25°C. After 5 days count the number of colonies and record the result. Colonies were counted and expressed as cfu/ g.

The microbial count can be calculated as:

$$N = A \times D$$

Where,

N = Number of colonies, (cfu/g)

A = Average count of colonies in petri plates

D = Dilution factor

Statistical Analysis

All the experiments were carried out in triplicates. The data obtained from the study were expressed as the mean value of standard deviation.

RESULTS AND DISCUSSIONS

The results obtained from the work done on amla-papaya jam incorporated with honey were analysed for proximate, physico-chemical, mineral composition, sensory attributes and microbial safety.

Proximate Composition

The proximate composition of amla-papaya jam incorporated with honey were analysed and the results were given in the "Table 2".

Table 2: Proximate Composition of Amla-Papaya Jam Incorporated with Honey

Parameters	Control	Sample-A	Sample-B
Moisture (%)	34.02 ± 1.44	32.98 ± 1.86	32.08 ± 1.05
Protein (%)	1.35 ± 0.03	1.54 ± 0.08	1.58 ± 0.04
Fat (%)	0.04 ± 0.01	0.09 ± 0.07	0.13 ± 0.02
Ash (%)	2.67 ± 0.28	2.82 ± 0.38	3.06 ± 0.46
Crude fiber (%)	1.76 ± 0.44	1.84 ± 0.02	1.89 ± 0.08
Carbohydrate (%)	60.16 ± 0.98	60.99 ± 0.61	61.31 ± 0.54

Note: All values expressed as mean ± SD

On analysis, significant ($P<0.05$) differences were observed in moisture content for control (34.02%), sample-A (32.98%) and sample-B (32.08%); in ash content for control (2.67%), sample-A (2.82%) and sample-B (3.06%); and in carbohydrate content for control (60.16%), sample-A (60.99%) and sample-B (61.31%). Whereas, no significant ($P>0.05$) differences were observed in protein content for control (1.35%), sample-A (1.54%) and sample-B (1.58%); in fat content for control (0.04%), sample-A (0.09%) and sample-B (0.13%); and in crude fibre content for control (1.76%), sample-A (1.84%) and sample-B (1.89%).

Physico-Chemical Parameters and Mineral Composition

The physico-chemical parameters and mineral composition of amla-papaya jam incorporated with honey were analysed and the results were given in the "Table 3".

Table 3: Physico-Chemical Parameters and Mineral Composition

Parameters	Control	Sample-A	Sample-B
pH	3.26 ± 0.16	2.85 ± 0.64	2.98 ± 0.78
TSS (%)	68.00 ± 0.24	68.32 ± 1.02	69.02 ± 1.36
Titrable acidity (%)	0.74 ± 0.21	0.63 ± 0.22	0.68 ± 0.12
Ascorbic acid (mg/100g)	68.02 ± 0.28	73.64 ± 0.65	88.38 ± 0.44
Calcium (mg/100g)	31.80 ± 0.68	34.56 ± 0.97	40.34 ± 0.76
Phosphorus (mg/100g)	2.02 ± 0.06	2.24 ± 0.49	2.89 ± 0.03
Iron (mg/100g)	1.62 ± 0.29	1.68 ± 0.08	1.74 ± 0.45

Note: All values expressed as mean ± SD

On analysis, significant ($P<0.05$) differences were observed in the values of pH for control (3.26), sample-A (2.85) and sample-B (2.98); in total soluble solids for control (68.00%), sample-A (68.32%) and sample-B (69.02%); in calcium content for control (31.80 mg/100g), sample-A (34.56 mg/100g) and sample-B (40.34 mg/100g); and in ascorbic acid (vitamin-C) content for control (68.02 mg/100g), sample-A (73.64 mg/100g) and sample-B (88.38 mg/100g). Whereas, no significant ($P>0.05$) differences were observed in titrable acidity for control (0.74%), sample-A (0.63%) and sample-B (0.68%); in phosphorus content for control (2.02 mg/100g), sample-A (2.24 mg/100g) and sample-B (2.89 mg/100g); and in iron content for control (1.62 mg/100g), sample-A (1.68 mg/100g) and sample-B (1.74 mg/100g).

Sensory Evaluation

The organoleptic evaluation of control and experimental samples were done for colour, taste, consistency, appearance and overall acceptability andthe data were expressed in terms of mean scores on a 9 point hedonic scale and presented in the "Table 4".

Table 4: Organoleptic Evaluation of Amla-Papaya Jam Incorporated with Honey

Attributes	Control	Sample-A	Sample-B
Colour	6. 01 ± 0.62	6.33 ± 0.04	7.31 ± 0.68
Taste	6.39 ± 0.54	6.62 ± 0.09	7.25 ± 0.84
Consistency	5.32 ± 0.05	5.45 ± 0.28	7.48 ± 0.14
Appearance	5.67 ± 0.43	5.84 ± 0.56	7.64 ± 0.25
Overall acceptability	6.10 ± 0.29	6.28 ± 0.44	7.28 ± 0.08

Note: All values expressed as mean ± SD

On analysis, significant ($P<0.05$) differences were observed in colour for control (6.01), sample-A (6.33) and sample-B (7.31); in taste for control (6.39), sample-A (6.62) and sample-B (7.25); in consistency for control (5.32), sample-A (5.45) and sample-B (7.48); in appearance for control (5.67), sample-A (5.84) and sample-B (7.64); and overall acceptability for control (6.10), sample-A (6.28) and sample-B (7.28).

Microbial Analysis

The microbial load of the amla-papaya jam incorporated with honey was analysed and the results were presented in the "Table 5".

Table 5: Analysis of Microbial Count of Amla-Papaya Jam Incorporated with Honey

Microbial Limit Test	Control	Sample-A	Sample-B
Bacterial count (cfu/g)	15.82 ± 0.16	14.01 ± 0.90	11.04 ± 0.15
Fungal count (cfu/g)	19.16 ± 0.80	18.54 ± 0.22	14.02 ± 0.48

Note: all values expressed as mean ± SD

On analysis, significant (P<0.05) differences were observed in the values of bacterial count for control (15.82 cfu/g), sample-A (14.01 cfu/g) and sample-B (11.04 cfu/g); and fungal count for control (19.16 cfu/g), sample-A (18.54 cfu/g) and sample-B (14.02 cfu/g).

SUMMARY AND CONCLUSIONS

The results of this study indicated that, the sample-B is favourably compared with both the control and sample-A in proximate composition, physico-chemical properties, mineral composition, sensory evaluation and microbial analysis. In proximate analysis results would show that the sample-B recorded high values in case of carbohydrate content and ash content. In physico-chemical properties the total soluble solids, calcium and ascorbic acid are relatively high in sample-B compared to both the control and sample-A. The mean scores of sample-B had good overall acceptability and is favourably compared with both the control and sample-A. The sample-B recorded low count in case of both the bacterial and fungal colonies compared to both the control and sample-A. Hence, from the present study, it can be concluded that the sample-B is more nutritious and highly acceptable than the control and sample-A.

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